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ABSTRACT

In spring 1986 Anglo students received higher scores than Blacks or Hispanics on the Iowa Tests of Basic Skills (ITBS), on all subtests and at all grade levels in the Denver (Colorado) Public Schools. This study, by attempting to locate patterns of item response, seeks to identify items in the ITBS that suggest differential pupil achievement by racial or ethnic group. Discriminant analyses of items missed on each subtest of the ITBS by members of each ethnic group were done for pupils in grades 1, 2, 5, 7, and 8. The following results were discovered: (1) there is a nonchance relationship between a pupil's racial or ethnic designation and his or her right-wrong response pattern; (2) knowing nothing more than the pupil's response pattern, one can predict with from 58 to 73 percent accuracy the pupil's racial or ethnic designation; (3) the accuracy of the prediction increases as the age of the pupil increases; (4) the Vocabulary subtest provides the best means to predict whether a pupil is Black, Hispanic, or Anglo; (5) the subtests in Spelling, Capitalization, Punctuation, and Mathematics Computation have the least predictive power; and (6) those subtests requiring knowledge of specialized vocabulary and reading skills were generally stronger predictors than those that require application of rules or the use of memory or recall. The single easiest and potentially most effective instructional activity that will improve minority test scores is vocabulary building, with emphasis on nonvernacular, specialized words. Appendices provide data on graphs and tables, and describe the method of analysis. (BJV)

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DENVER PUBLIC SCHOOLS
Department of Planning, Research, and Development

A study to identify items on the Iowa Tests of Basic Skills which are associated with racial or ethnic group membership; to determine possible relationships between instructional needs and these items; and to develop recommendation strategies.

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February 1987

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INTRODUCTION

During a Superintendent's staff meeting in the fall of 1986, the differences between minority and Anglo pupils' spring 1986 ITBS test scores were discussed. For all subtests, at all grade levels, there was a large differential between Anglo and Black, and Anglo and Hispanic pupils' scores, favoring, in each case, Anglo pupils.

The Superintendent requested that a design be developed which focused on the test score differential and delineated a process for developing an analysis of current information which will aid in developing instructional programs for use next school year to improve minority pupil learning.

The design was based on the most sensitive bit of test data that was available, the individual test items.

PURPOSE OF THE STUDY

The problem was to identify items in the Iowa Tests of Basic Skills that would identify differential pupil achievement by racial or ethnic group. Would it be possible to identify a pattern of item response that is associated with belonging to a given racial or ethnic group? If such a set of items could be found, it could serve as a base for determining what minority pupils have not learned that Anglo pupils have, and why.

METHOD OF PROCEDURE

This study involved an analysis of items missed for each racial or ethnic group and, also, examined measures of association between items and racial/ethnic group membership.

The first step in the study was to make an item analysis for each item in each subtest to determine the percent of pupils answering those items correctly. This analysis was done for Anglo, Black, and Hispanic pupils at a given grade level. These data allow one to determine which group of pupils--Black, Hispanic, or Anglo--has the highest percentage of correct responses for each item on the test.

The second step was to analyze discrepancies of these percent correct scores between Anglo and Hispanic pupils and between Anglo and Black pupils. This analysis was done to determine if there was a response pattern among the questions on each subtest that would predict whether a pupil would be Hispanic or Anglo, or Black or Anglo. A statistical procedure called discriminant analysis was used to accomplish this. A description of this technique can be found in Appendix C.

The third step was to take those test questions that were found by the discriminant analysis to be strong predictors of racial or ethnic group membership and examine them as to reasons why this might be so.

The fourth step was to make some recommendations based on the item examination in step three relative to instructional practices that would help to improve knowledge acquisition and test scores, particularly those of minority pupils.

Item analyses were done for all grades.

Discriminant analyses were done for grades 1, 2, 5, 7, and 8. The number of pupils represented at each grade level in the item and discriminant analyses is approximately 4000.

The subtests that were analyzed in this manner were Vocabulary, Reading, Spelling, Capitalization, Punctuation, Language Usage, Visual Materials, Reference Materials, Mathematics Concepts, Mathematics Problem Solving, Mathematics Computation, Social Studies, and Science.

FINDINGS

The discriminant analysis indicated that:

- . At each grade level (1, 2, 5, 7, and 8) there is a nonchance relationship between a pupil's racial or ethnic designation and his right-wrong response pattern on each subtest of the ITBS.
- . Knowing nothing more than the pupil's response pattern to questions on a subtest, one can predict with from 58 to 73 percent accuracy the pupil's racial or ethnic designation. (The accuracy of a chance level of prediction would be 50%.)
- . This ability to predict racial or ethnic group membership (better than chance 50/50) holds for every subtest on the battery at every grade analyzed (1, 2, 5, 7, and 8).
- . The accuracy of the prediction increases as the age of the pupils taking the tests increases.
- . The subtest that has the greatest power to predict whether a pupil is Hispanic or Anglo, or Black or Anglo, is the Vocabulary subtest.
- . The subtests that have the least predictive power to differentiate between Black and Anglo, or Hispanic and Anglo pupils, are Spelling, Capitalization, Punctuation, and Mathematics Computation.
- . Those subtests requiring knowledge of specialized vocabulary and reading skills (Social Studies, Science, Mathematics Problem Solving, Mathematics Concepts, English Usage, Visual and Reference Materials) were generally stronger predictors than those that require application of rules or the use of memory or recall (Spelling, Capitalization, Punctuation, and Mathematics Computation).

The examination of the test questions found to be strong predictors revealed that:

For virtually every item on the ITBS studied, a greater percent of Anglo pupils answered the item correctly than either Black or Hispanic pupils. Table I provides a comparison of percent of grade 3 Hispanic, Black, and Anglo pupils who correctly answered questions on the vocabulary subtest.

For every item on the vocabulary subtest, Black and Hispanic pupils scored well below the national percent correct, while for most items Anglo pupils scored at or above the national percent correct.

Table I indicates this vocabulary pattern for grade 3 only; however, this pattern is the same for all grade levels examined.

The questions that have the greatest power to predict racial or ethnic group membership are vocabulary loaded; i.e., they require the understanding of non-vernacular words or depend upon a student having an expanded vocabulary (e.g. asthma, lever, allergy, etc.).

Some questions that add strength to the predictions use language constructs that are similar to those found in Black English or Spanish (e.g., double negatives, verb usage, most big, and plurals).

Questions dealing with the ability to read, understand and interpret graphs, tables, charts, and maps differentiate between Black and Anglo, and Hispanic and Anglo pupils.

Questions involving alphabetizing skills differentiate between racial and ethnic groups.

Questions using a negative format (e.g., It is not true that....) differentiate between racial and ethnic groups.

TABLE I

PERCENT OF GRADE 3 BLACK,
HISPANIC AND ANGLO PUPILS
WHO RESPONDED CORRECTLY TO
VOCABULARY QUESTIONS ON
LEVEL 9 ITBS

PERCENT OF GRADE 3 BLACK, HISPANIC AND ANGLO PUPILS WHO RESPONDED CORRECTLY TO VOCABULARY QUESTIONS ON LEVEL 9 ITBS			Anglo		Hispanic		Black	
Vocabulary Area	Item No.	National % Correct	DPS % correct	Difference between National and DPS %	DPS % Correct	Difference between National & DPS %	DPS % Correct	Difference between National & DPS %
READING/LANGUAGE								
Reading	1	93	91	-2	80	-13	79	-14
Reading	8	58	57	-1	46	-12	45	-13
Reading	11	65	70	+5	49	-16	50	-15
Reading	14	57	64	+7	46	-11	48	- 9
Reading	15	70	76	+6	57	-13	61	- 9
Reading	23	41	42	+1	30	-11	29	-12
English & grammar	22	38	36	-2	22	-16	27	-11
WORK-STUDY/ SOCIAL STUDIES								
Magazines	6	80	79	+1	67	-13	68	-12
Library reference	26	52	60	+8	36	-16	39	-13
Library reference	27	43	41	-2	26	-17	26	-17
Library reference	29	34	36	+2	21	-13	20	-14
Social studies	10	53	53	0	34	-19	36	-17
Social studies	17	50	53	+3	34	-16	39	-11
MATHEMATICS/SCIENCE								
Mathematics	9	70	71	+1	54	-16	58	-12
Mathematics	13	84	88	+4	76	- 8	74	-10
Science	4	82	78	-4	63	-19	67	-15
Science	16	71	74	+3	51	-20	58	-13
Science	18	76	75	-1	57	-19	60	-16
Science	21	65	74	+9	52	-13	55	-10
Science	24	30	28	-2	21	- 9	18	-12
Science	28	40	39	-1	31	- 9	34	- 6
FINE & APPLIED ARTS								
Home economics	2	73	72	-1	51	-22	61	-12
Music	3	70	72	+2	50	-20	51	-19
Shop	5	80	78	-2	67	-13	65	-15
Home economics	7	69	68	-1	48	-21	48	-21
Music	12	69	69	0	54	-15	58	-11
Home economics	19	53	55	+2	39	-14	41	-12
Music	20	38	39	+1	31	- 7	33	- 5
Shop	25	53	53	0	31	-22	34	-19
Music	30	29	27	-2	20	- 9	23	- 6

Questions which require pupils to make connections between related but not specifically stated bits of information before the original question posed can be answered were found to differentiate between Black and Anglo, and Hispanic and Anglo pupils. (e.g., A pupil must know that cobras, pythons, and water moccasins are snakes before he can answer a question about the uses of reference books or that paper is made out of trees before he can answer a question on map reading.)

INSTRUCTIONAL IMPLICATIONS

The single easiest and potentially most effective instructional activity in which to engage that will improve minority test scores is vocabulary building, especially nonvernacular, specialized words. Every teacher, regardless of teaching area--math, social studies, science, reading, language arts, music, art, physical education--and at every grade level, should incorporate as part of a daily or at least weekly activity, the study of new words or review of previously used words relative to the lesson being taught. This is certainly incorporated as a standard teaching technique but should be greatly expanded, emphasized, and taught in a systematic, routine manner. Pupils' vocabulary development must not be assumed or left to chance.

This activity can be done at no additional cost and is non-invasive relative to instruction time and would fit in with any instructional mode or instructional philosophy adopted by a school.

In language arts instruction, particular attention should be paid to:

- . verb tense
- . verb-subject
- . double negatives
- . forming of plurals, especially words whose spelling and pronunciation are the same for the singular and plural forms (e.g., sheep, deer, you).

Practice exercises should be developed in social studies, science, mathematics and IMC instruction that deal with reading and interpreting graphs, tables, charts, and maps.

For example, at the seventh grade level, if Black pupils were to answer correctly, on the average, only seven more questions on the Visual Materials subtest, their percentile rank would improve from the 25th to the 50th (national norm for all pupils) percentile. Hispanic pupils would need to answer six more questions correctly to reach the national norm for all pupils.

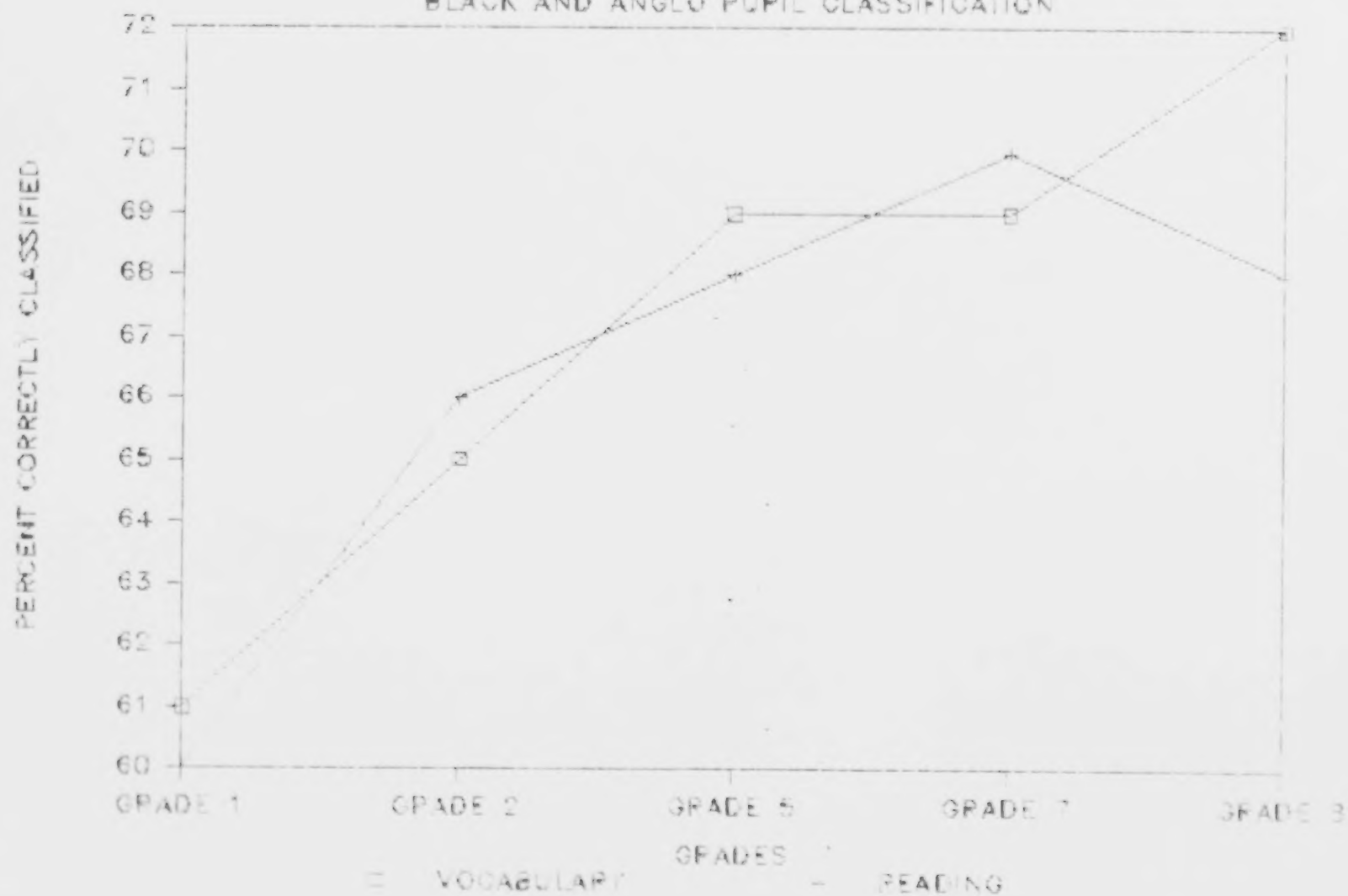
Practice exercises to develop pupil skills in alphabetizing also should be developed.

APPENDIX A

Graphs of Percents of Pupils
Correctly Classified by
Race or Ethnicity
by Grade and Subtest of the ITBS

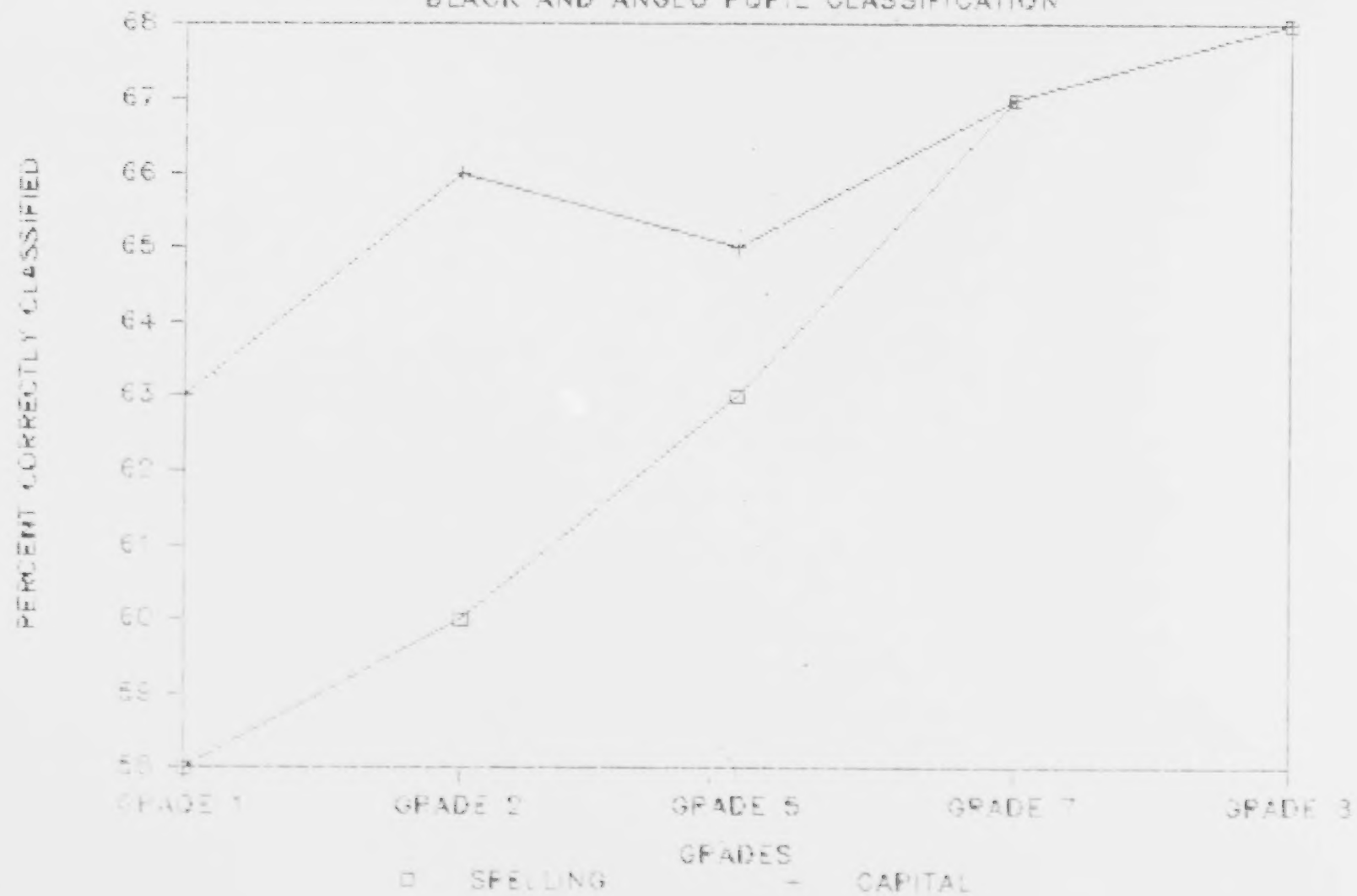
ITBS SCORES SPRING 1986

BLACK AND ANGLO PUPIL CLASSIFICATION



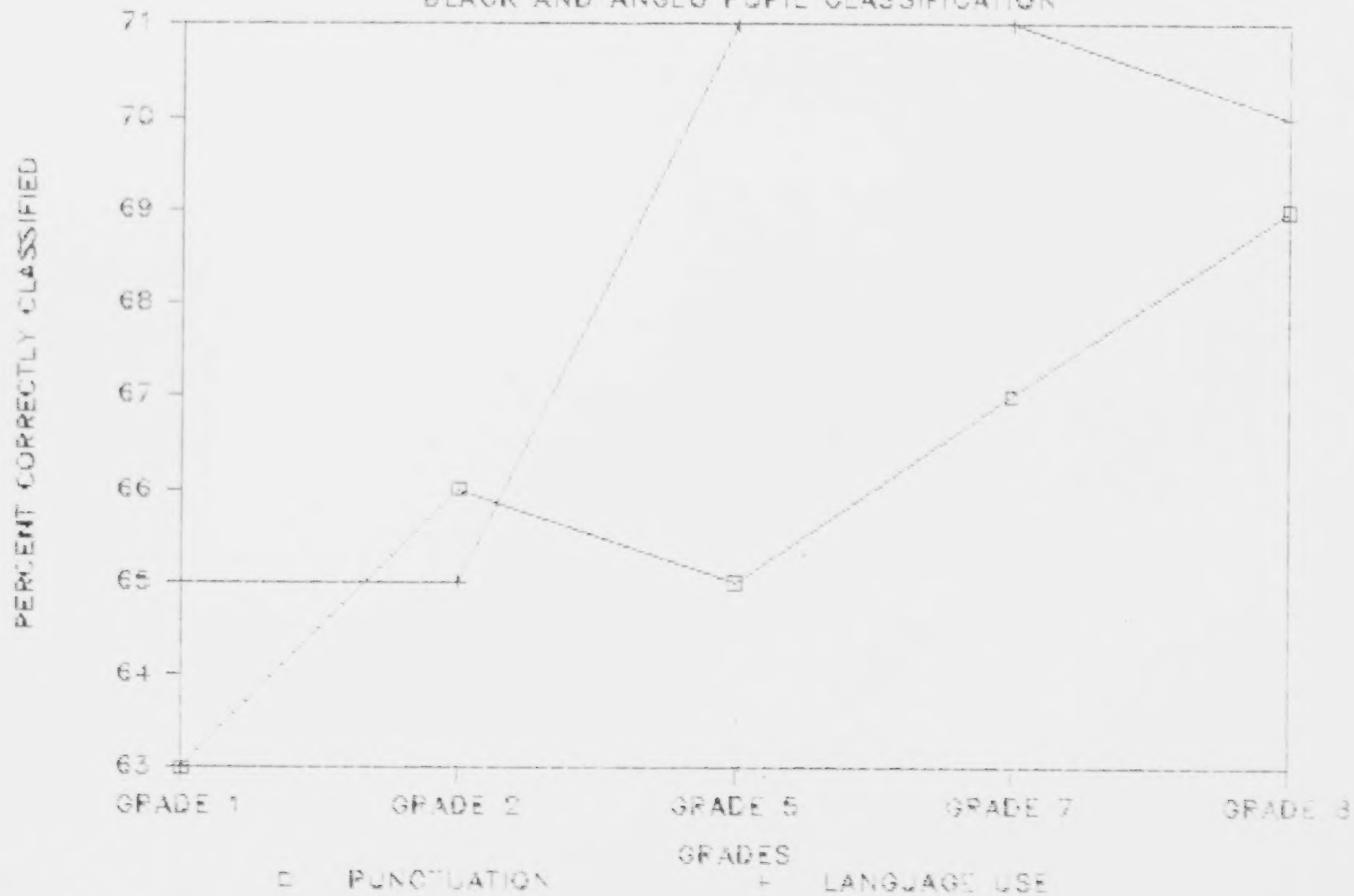
ITBS SCORES SPRING 1986

BLACK AND ANGLO PUPIL CLASSIFICATION



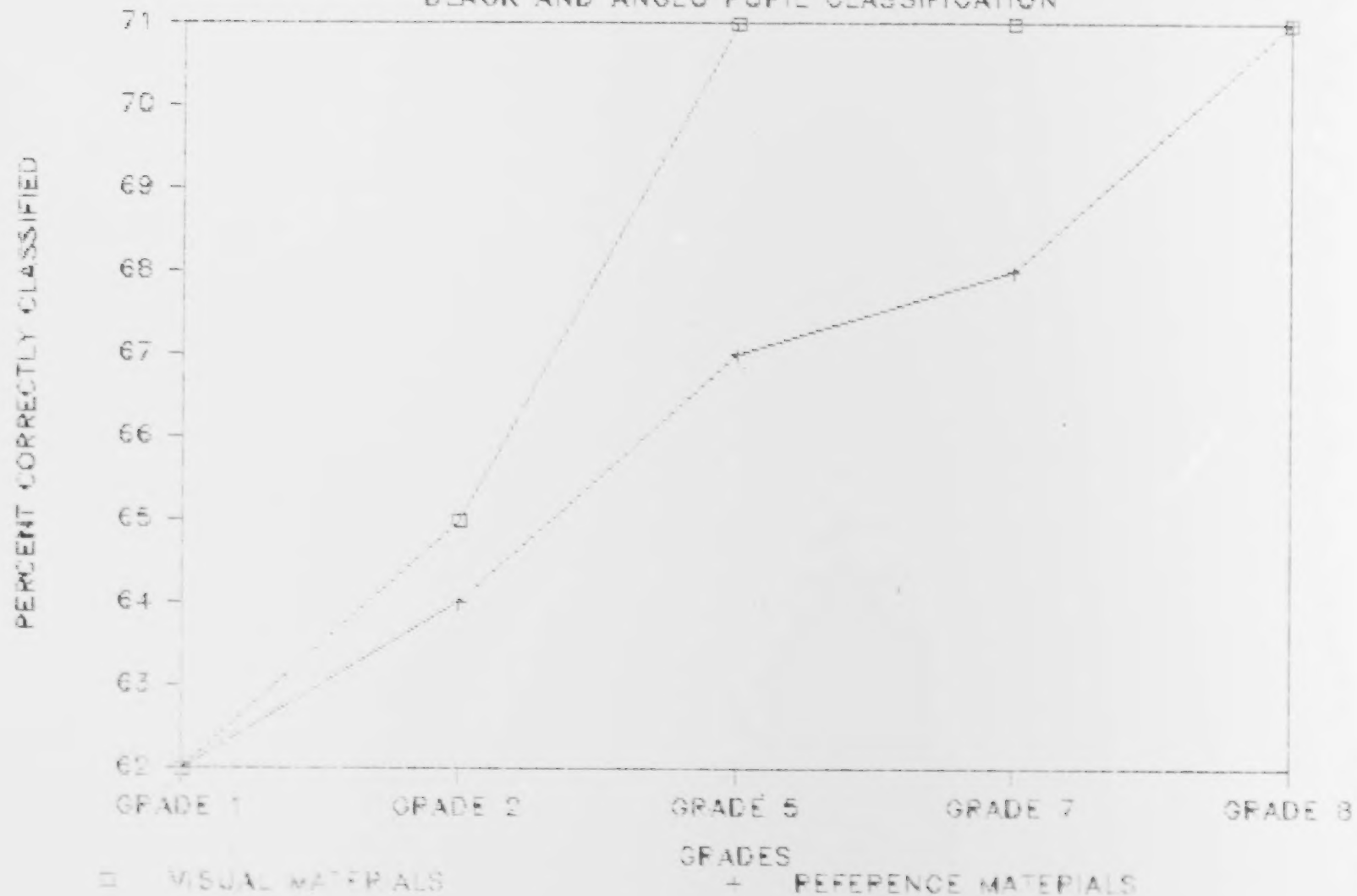
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BLACK AND ANGLO PUPIL CLASSIFICATION



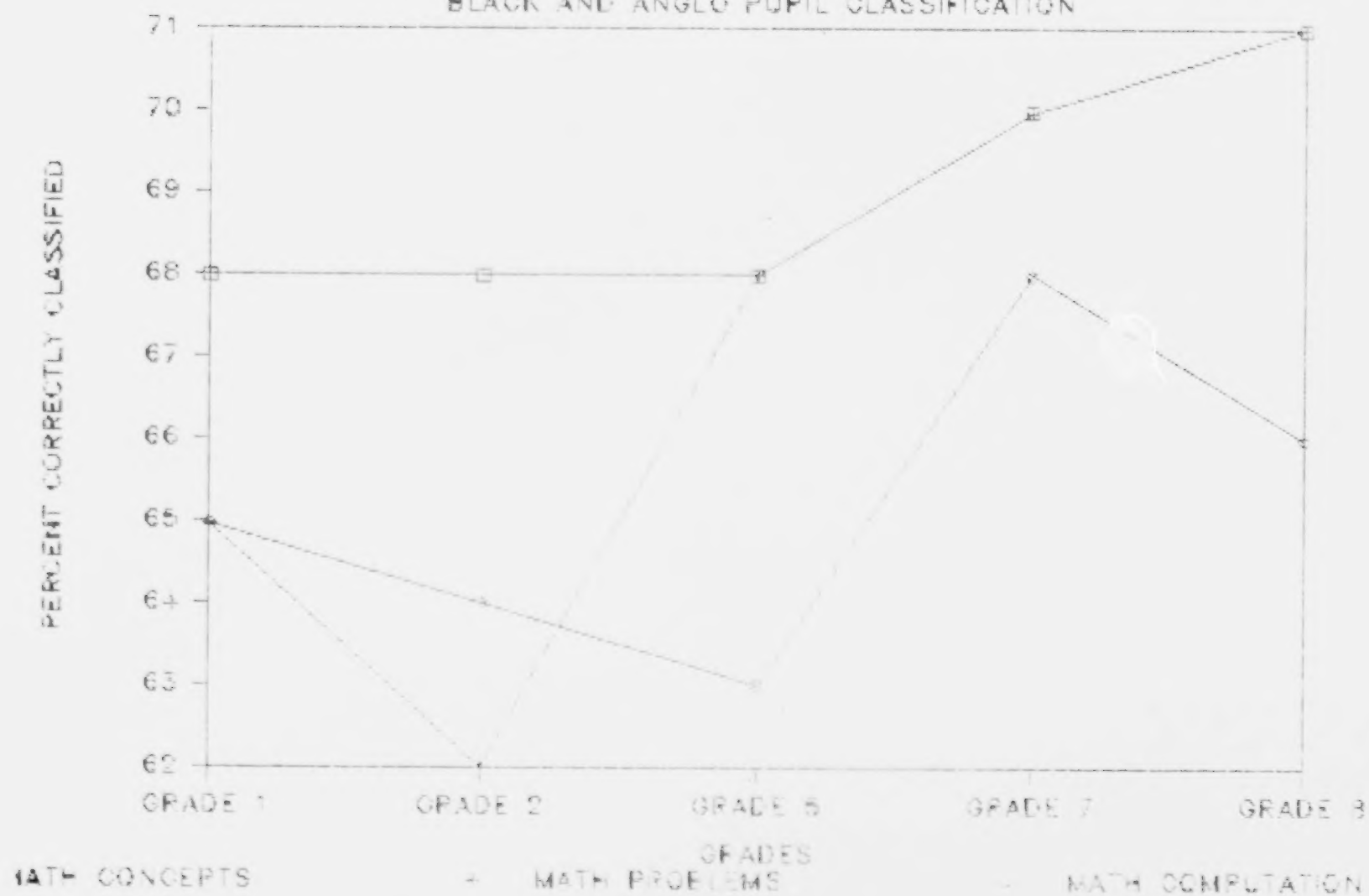
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BLACK AND ANGLO PUPIL CLASSIFICATION



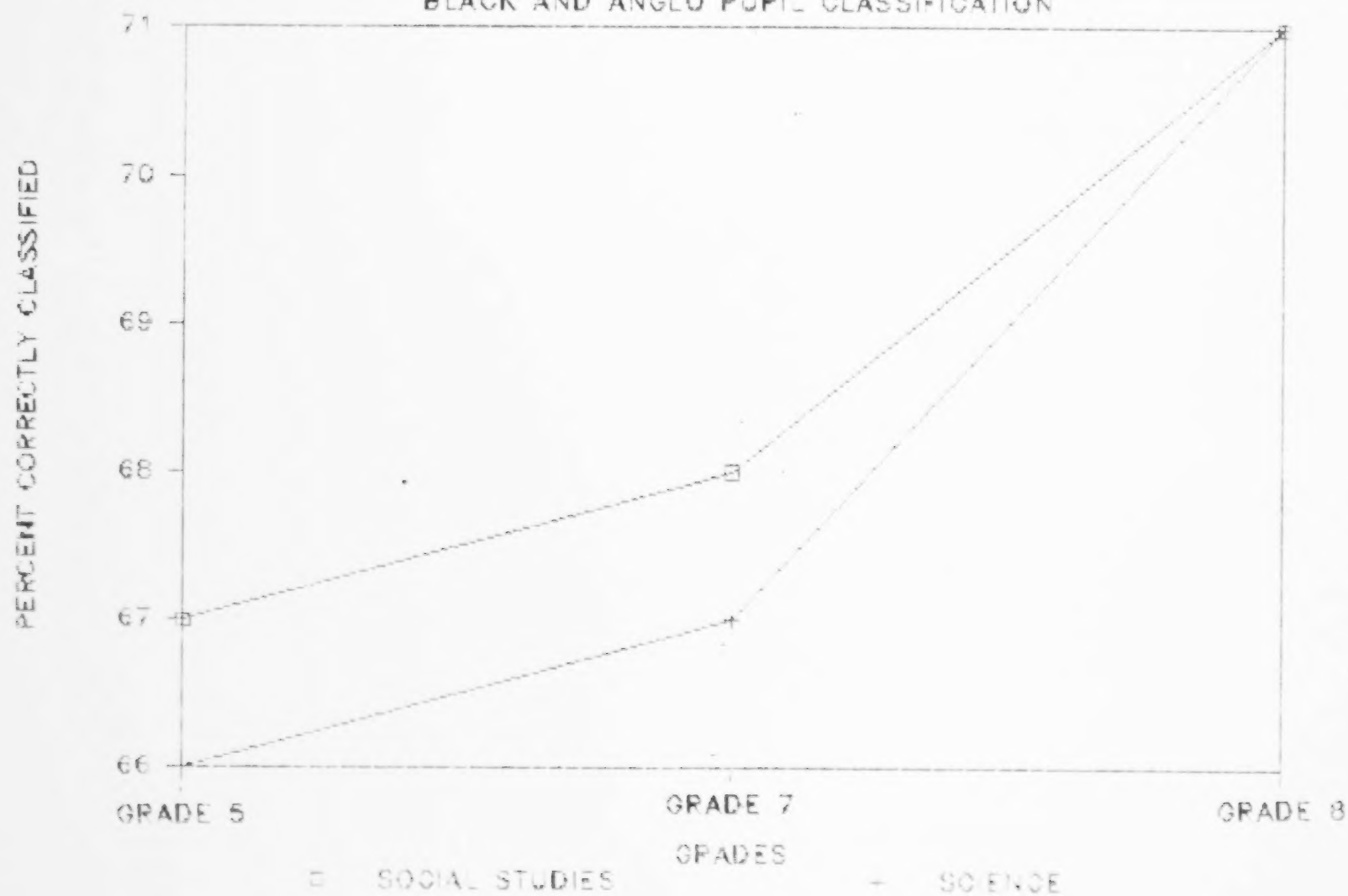
ITBS SCORES SPRING 1986

BLACK AND ANGLO PUPIL CLASSIFICATION



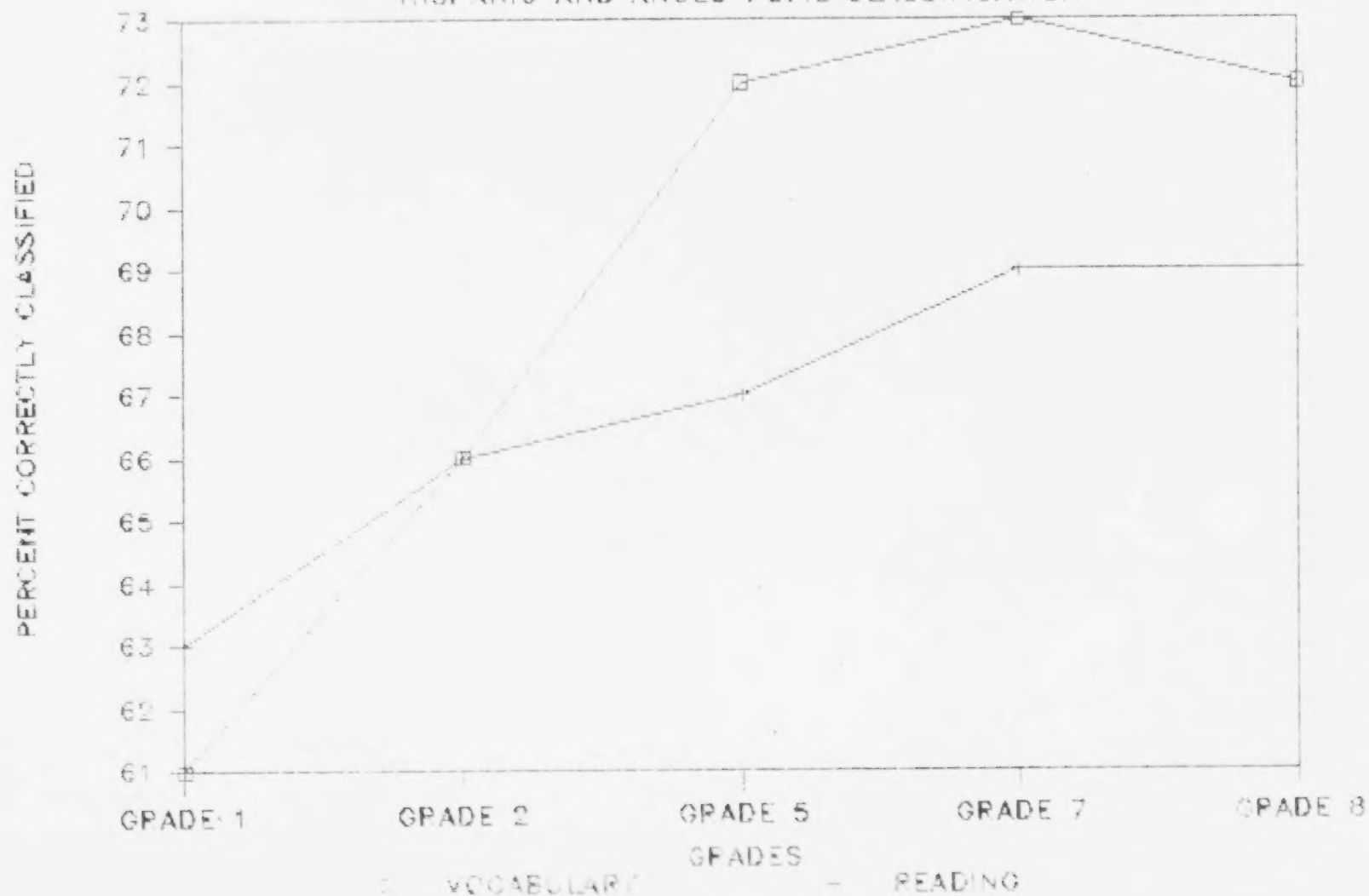
ITBS SCORES SPRING 1986

BLACK AND ANGLO PUPIL CLASSIFICATION



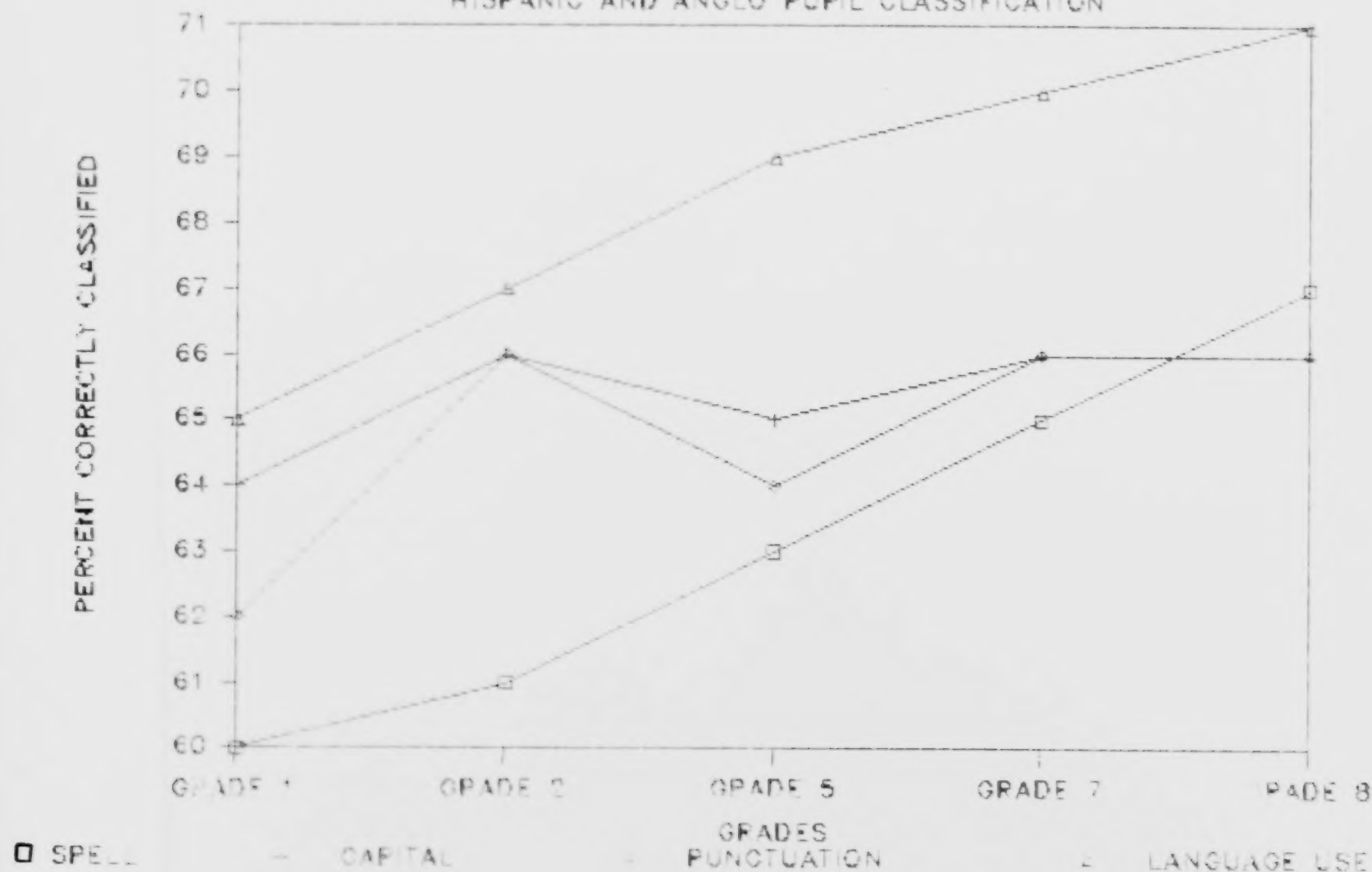
TBS SCORES SPRING 1986

HISPANIC AND ANGLO PUPIL CLASSIFICATION



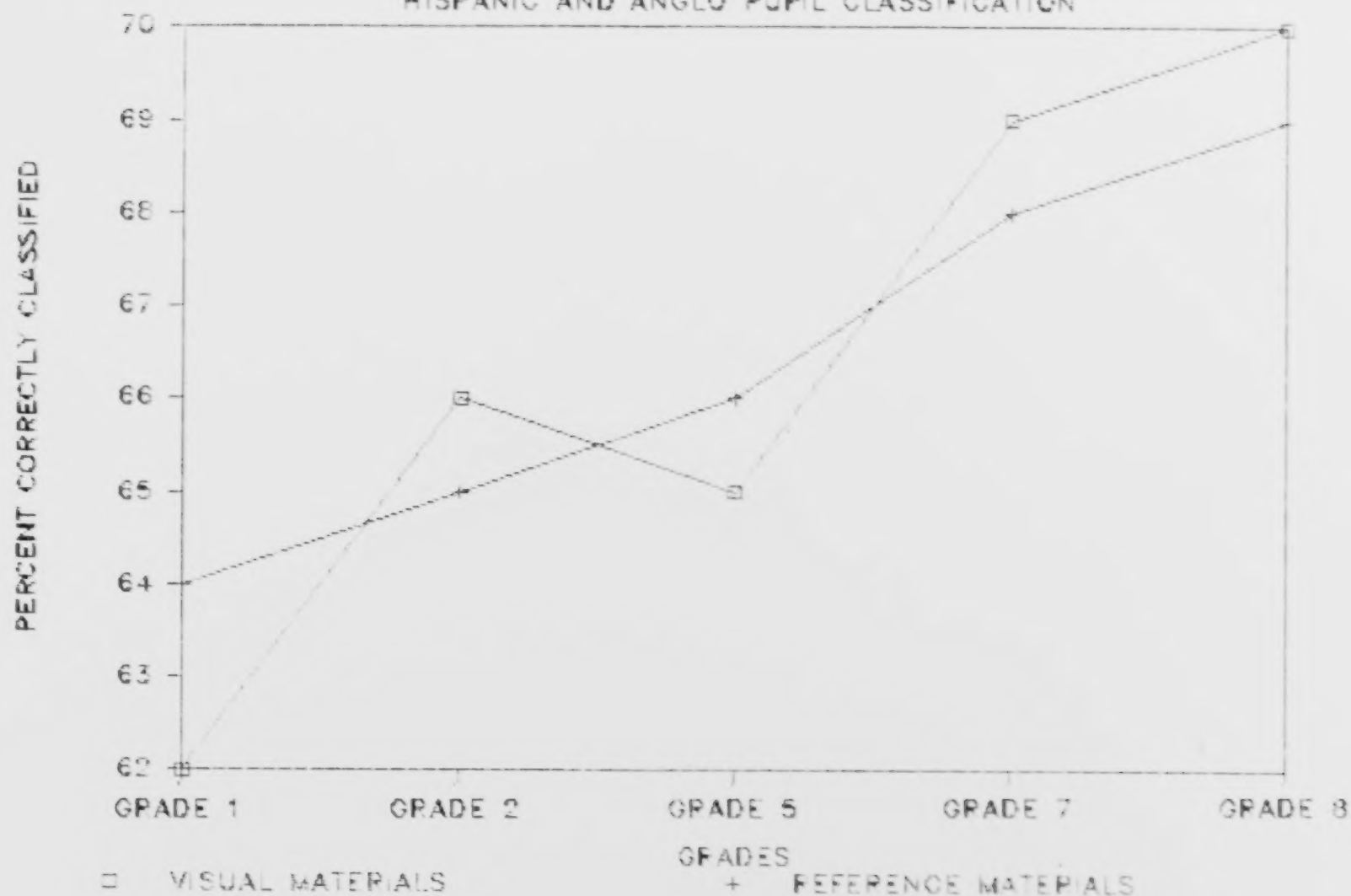
ITBS SCORES SPRING 1986

HISPANIC AND ANGLO PUPIL CLASSIFICATION



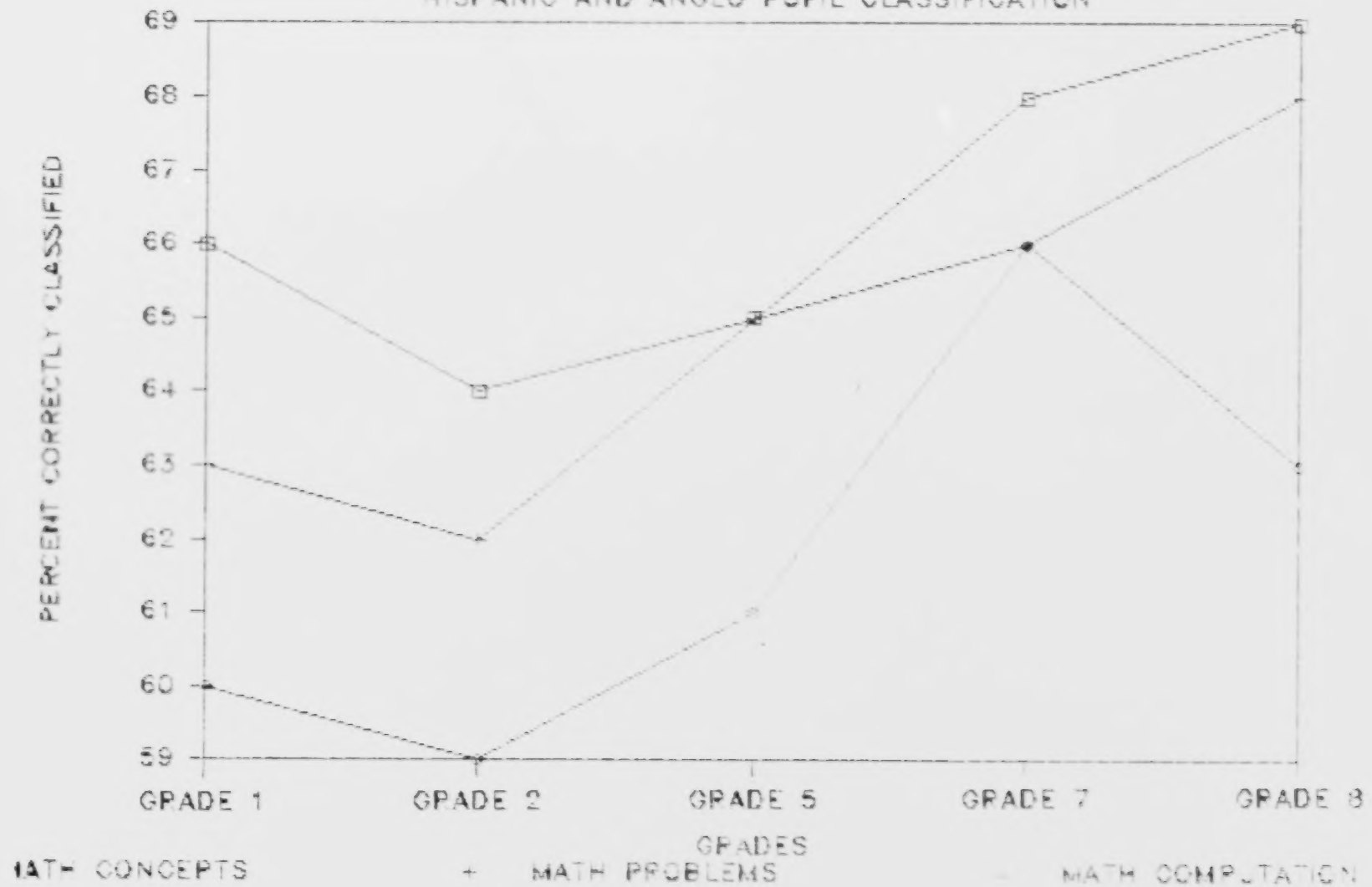
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HISPANIC AND ANGLO PUPIL CLASSIFICATION



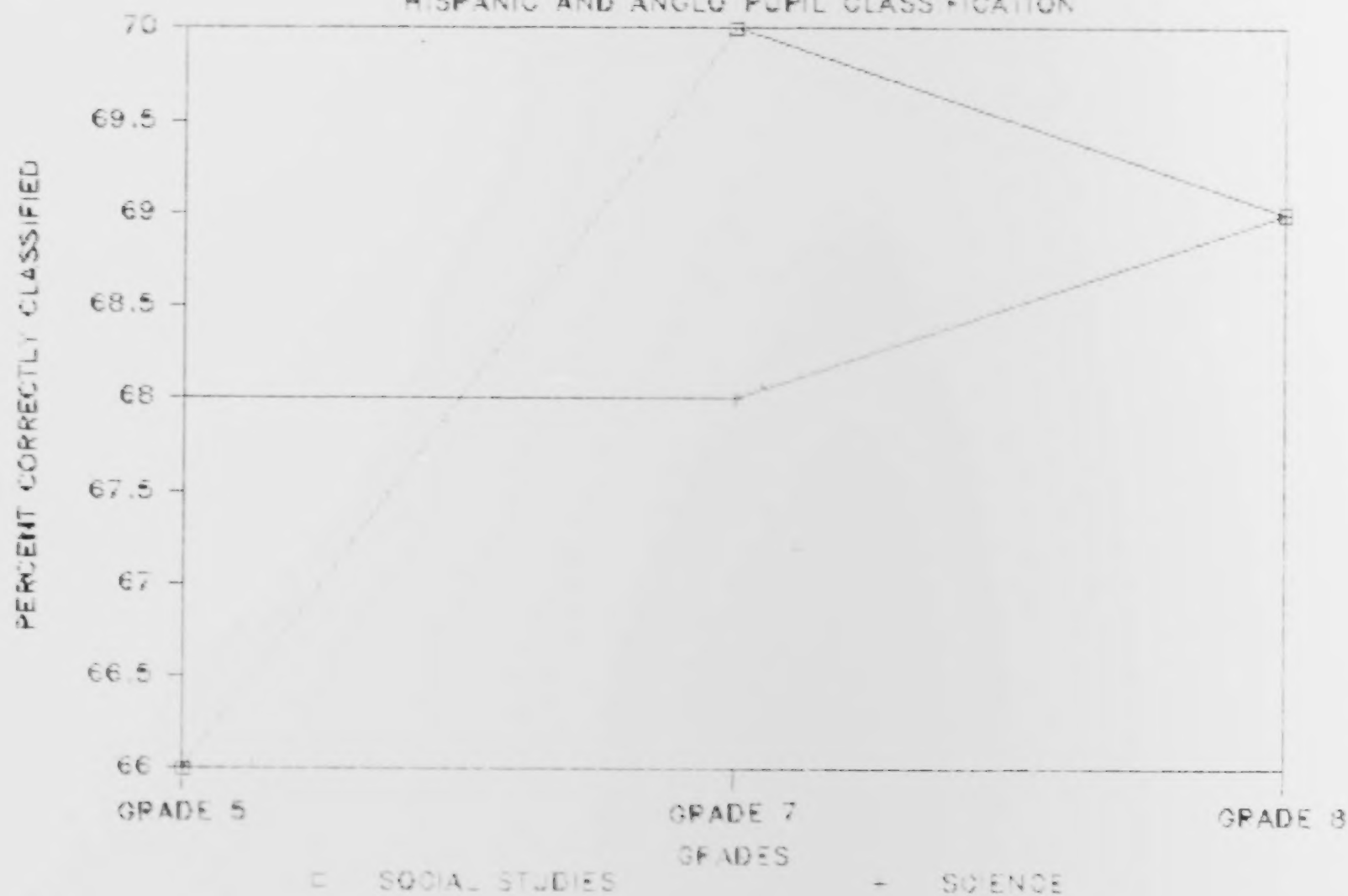
ITBS SCORES SPRING 1986

HISPANIC AND ANGLO PUPIL CLASSIFICATION



ITBS SCORES SPRING 1986

HISPANIC AND ANGLO PUPIL CLASSIFICATION



APPENDIX B

Cononical Correlations
and
Percent of Pupils Correctly Classified
by Race or Ethnicity
by Grade and Subtest of the ITBS

Canonical Correlations*
and
Percent of Anglo and Black Pupils
Correctly Classified by Race, Given by Grade and ITBS Subtest

	GRADE									
	1		2		5		7		8	
	Cor.	%	Cor.	%	Cor.	%	Cor.	%	Cor.	%
Vocabulary	.27	61	.35	65	.42	69	.44	69	.48	72
Reading	.27	60	.38	66	.42	68	.45	70	.44	68
Spelling	.17	58	.24	60	.31	63	.39	67	.39	68
Capitalization	.27	63	.36	66	.35	65	.39	67	.41	68
Punctuation	.30	63	.34	66	.34	65	.38	67	.41	69
Language Usage	.34	65	.31	65	.46	71	.48	71	.46	70
Visual Materials	.30	62	.36	65	.45	71	.48	71	.48	71
Reference Materials	.31	62	.32	64	.38	67	.41	68	.44	71
Math Concepts	.39	68	.38	68	.40	68	.46	70	.45	71
Math Problem Solving	.35	65	.30	62	.40	68	.45	70	.46	71
Math Computation	.27	65	.28	64	.31	63	.42	68	.33	66
Social Studies	--	--	--	--	.40	67	.42	68	.48	71
Science	--	--	--	--	.39	66	.42	67	.46	71

*All correlations significant at .05 level or less.
Sample size 2141 or larger at each grade level.

Canonical Correlations*
and
Percent of Anglo and Hispanic Pupils
Correctly Classified by Race or Ethnicity,
Given by Grade and ITBS Subtest

	GRADE									
	1		2		5		7		8	
	Cor.	%	Cor.	%	Cor.	%	Cor.	%	Cor.	%
Vocabulary	.28	61	.36	66	.49	72	.51	73	.50	72
Reading	.32	63	.39	66	.43	67	.44	69	.43	69
Spelling	.24	60	.26	61	.32	63	.35	65	.39	67
Capitalization	.30	64	.36	66	.35	65	.36	66	.37	66
Punctuation	.30	62	.35	66	.34	64	.36	66	.37	66
Language Usage	.33	65	.38	67	.41	69	.46	70	.45	71
Visual Materials	.30	62	.37	66	.37	65	.46	69	.44	70
Reference Materials	.35	64	.35	65	.37	66	.41	68	.42	69
Math Concepts	.37	66	.34	64	.35	65	.43	68	.44	69
Math Problem Solving	.33	63	.31	62	.35	65	.37	66	.41	68
Math Computation	.19	60	.22	59	.25	61	.36	66	.32	63
Social Studies	--	--	--	--	.39	66	.44	70	.44	69
Science	--	--	--	--	.42	68	.43	68	.45	69

*All correlations significant at .05 or less.
Sample size 2450 or larger at each grade level.

APPENDIX C

A Discription of Discriminant Analysis

Method of Analysis

Data were analyzed using discriminant and classification analysis techniques. Discriminant analysis begins with distinguishing statistically between two or more groups of cases. To distinguish between the groups, a set of hypothesized discriminating variables that measure characteristics on which the groups are expected to differ is selected and a discriminant function is created. A test of significance is made to determine if the null hypothesis is to be rejected. If the null hypothesis is rejected, the next step is to test the predictive power of the classification functions.

The mathematical objective of discriminant analysis is to weight and linearly combine the discriminating variables in some fashion so that the groups are forced to be as statistically distinct as possible. The intent is to "discriminate" between the groups in the sense of being able to tell them apart. Discrimination analysis does this by forming one or more linear combinations of the discriminating variables. These "discriminant functions" are of the form:

$$Y_i = d_{i1} X_1 + d_{i2} X_2 + d_{i3} X_3 + d_{i4} X_4 + \dots \\ + d_{ip} X_p$$

where y_i is the score on discriminant function i , and d 's are weighting coefficients, and the X 's are the standardized values of the p discriminating variables used in the analysis (Klecka, 1975).

The problem of discriminant analysis is to select the combining weights d_1, d_2, d_3 , through d_p in such a fashion that these values will maximize the differences between or among the mean values of the transformed variables Y_i for each group under consideration (Tatsuoka, 1970). The maximum number of functions which can be derived is one less than the number of groups. Once the discriminant functions have been derived, the two research objectives of this technique, analysis and classification, may be

pursued. The analysis aspects of this technique provide for statistical tests for measuring the success with which the discriminating variables actually discriminate when combined into the discriminant functions (Klecka, 1975). The use of discriminant analysis as a classification technique comes after the initial computation. Once a set of variables is found which provides satisfactory discrimination for cases with known group memberships, a set of classification functions can be derived which will permit the classification of new cases with unknown memberships. The procedure for classification involves the use of a separate linear combination of the discriminating variables for each group. These produce a probability of membership in the respective group and the case is assigned to the group with the highest probability (Klecka, 1975).

In this study, step-wise discriminant functions were calculated, using the ethnic group membership of each pupil as the criterion and each pupil's right/wrong response vector for each subtest as predictor variables. The step-wise method of selecting predictor variables provides for a set of predictor variables that is less than the original set. In some instances, the full set of predictor variables contains excess information about group differences or are not useful in discriminating between groups and are not necessary. By sequentially selecting the "next best" discriminator at each step, a reduced set of variables will be found that will be almost as good as, and sometimes better than, the first set (Klecka, 1975).

The criterion used to select predictor variables for the discriminant functions was Rao's V, a generalized distance measure. The variable selected is the one which contributes the largest increase in Rao's V when added to the previous variables which amounts to the greatest overall separation among the groups (Klecka, 1975). A variable was considered for selection only if its partial multivariate F ratio was at least 1.0 since only F ratios greater than one are significant. Likewise, a variable was considered for removal if its multivariate F was less than 1.0.

The adequacy of the derived discriminant functions was tested by classifying the cases used to derive the functions in the first place and comparing case by case predicted group membership with actual group membership.

Classification is achieved through the use of a series of classification functions, one for each group being predicted. There is a separate function for each group. The equation for group i is given by:

$$c_i = c_{i1} Y_1 + c_{i2} Y_2 + c_{i3} Y_3 + \dots + c_{ij} Y_j + c_{i0}$$

Where c_i is the classification score for group i , c_{ij} the classification coefficients, c_{i0} is a constant and Y_j the discriminant function score. Classification scores are converted into probability of group membership and each case is assigned to the group for which it has the greatest probability of belonging (Klecka, 1975).

The final step in classification compared the results (number of pupils correctly classified) of the case by case classification, using the classification functions with what one would expect by chance alone. The actual predicted frequencies were compared to expected frequencies, using the Chi-square statistic, thus empirically measuring the success in discrimination by observing the extent to which the classifications based on the discriminant functions differed from chance classifications.

REFERENCES

Klecka, W. R. Discriminant analysis. Statistical package for the social sciences (2nd ed.). New York: McGraw-Hill, 1975.

Tatsuoka, M. M. Selected topics in advanced statistics: An elementary approach, number 6. Discriminant analysis: The study of group differences. Champaign, Ill.: Institute for Personality and Ability Testing, 1970.